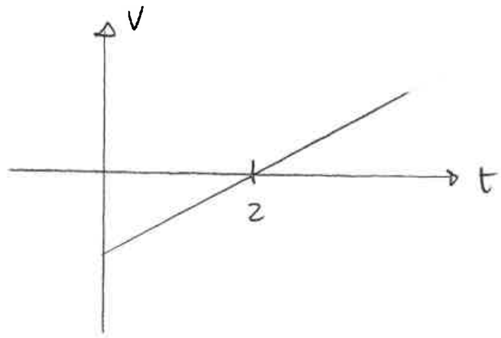
~~2015 Supp Ex 8~~

2016 Supp Ex 10

Consider the slope of the graph which gives velocity

Ant: Before 2s the slope is negative

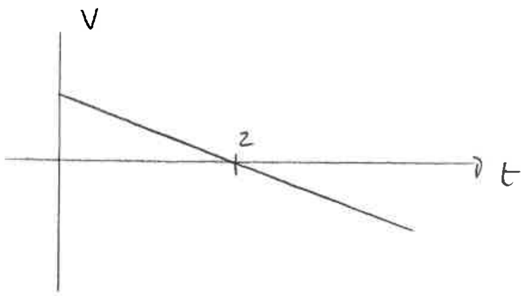
After 2s " " " positive



Velocity increases at all times $\Rightarrow$ acceleration > 0 $\Rightarrow$ $\boxed{ii}$

Bug: Before 2s slope is positive + decreasing

After 2s " " negative + "



Velocity decreases at all times $\Rightarrow$ acceleration < 0 $\Rightarrow$ $\boxed{iii}$

2016 Supp Ex 12

a) moves left slowing down
at 2.5s reverses then moves . right speeding up.

b),c) At 2.0s $V = -1.0 m/s$
At 3.0s $V = 1.0 m/s$ different velocities

So speed is same

d) Since velocity increases it will be positive

e) Accel = slope of v vs t
The slope is constant ⇒ accel is constant

f) $a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} = \frac{1.0 m/s - (-1.0 m/s)}{3.0 s - 2.0 s}$

$\Rightarrow a_{avg} = 2.0 m/s^2$

Knight Ch2

Conc Q 13.

In all cases during free fall the acceleration of any object is

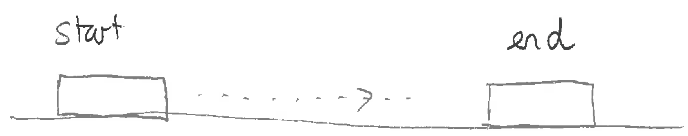
$a_y = -g$

Both a,b are free fall motion so $a_y = -g$ and the magnitude of the acceleration is g

Knight Ch2

~~Prob 16~~

4ed Prob 18



$t_i = 0s$ $\quad$ $t_f = ??$

$x_i = 0m$ $\quad$ $x_f = 400m$

$v_i = 0m/s$ $\quad$ $v_f = ??$

Need time taken for both cars. If acceleration is constant then

$$x_f = x_i + v_i \Delta t + \frac{1}{2} a(\Delta t)^2$$

$$x_f - x_i = \cancel{v_i}^{0} \Delta t + \frac{1}{2} a \Delta t^2 \Rightarrow x_f - x_i = \frac{1}{2} a (\Delta t)^2$$

$$\Rightarrow \frac{2(x_f - x_i)}{a} = (\Delta t)^2$$

$$\Rightarrow \Delta t = \sqrt{\frac{2(x_f - x_i)}{a}} = \sqrt{\frac{2 \times 400m}{a}}$$

Porsche $\quad a = 3.5 m/s^2 \Rightarrow \Delta t = \sqrt{\frac{800m}{3.5m/s^2}} = 15.2s$

Honda $\quad a = 3.0m/s^2 \Rightarrow \Delta t = \sqrt{\frac{800m}{3.0m/s^2}} = 16.3s$

Even with a 1s lag (the Porsche would finish in 16.2s) the Porsche still wins

Knight Ch2

~~Prob 19~~

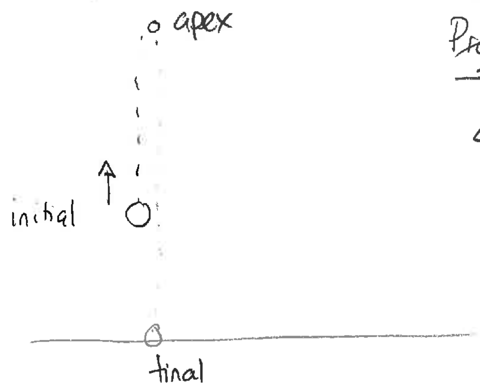
4ed Prob 21

$y_i = 2.0m$ $\quad$ $y_f = 0.0m$

$V_{yi} = 15 m/s$ $\quad$ $V_{yf} = ?$

$t_i = 0s$ $\quad$ $t_f = ?$

$a = -9.8 m/s^2$



$$y_f = y_i + V_{yi}\Delta t + \tfrac{1}{2}a(\Delta t)^2$$

$$0m = 2.0m + 15m/s\,\Delta t - 4.9m/s^2(\Delta t)^2$$

roots $\quad$ $$\Delta t = \frac{-15m/s \pm \sqrt{15^2 m^2/s^2 - 4\times 2.0m \times(-4.9m/s^2)}}{2(-4.9m/s^2)}$$

$$= \frac{-15 \pm \sqrt{264.2}}{-9.8}\,s$$ only negative root contributes

$\Rightarrow \Delta t = 3.2s$

$\boxed{\text{OR}}$ time to reach apex $\quad V_a = 0m/s$

$V_a = V_{yi} + a\Delta t \Rightarrow -15m/s = -9.8m/s^2\,\Delta t$

$\Rightarrow \Delta t = 1.5s$

apex height $\quad y_a = y_i + V_{yi}\Delta t + \tfrac{1}{2}a(\Delta t)^2 = 13.0m$

time to drop $\quad y_f = y_a + \cancel{V_a\Delta t}^{\,0} + \tfrac{1}{2}a(\Delta t)^2 \Rightarrow -13.0m = -4.9m/s^2\,\Delta t$

$= 1.63s$

total $= 3.1s$

Knight Ch 2

~~Prob 45~~

4 ed Prob 49a

a)

	1	2	3
	when deer steps out	reaction	stop
time	$t_1 = 0\,s$	$t_2 = 0.50\,s$	??
position	$x_1 = 0\,m$	$x_2 =$	??
speed	$v_1 = 20\,m/s$	$v_2 = 20\,m/s$	$v_3 = 0\,m/s$

$$\underbrace{v_2 \quad v_3}_{a = -10\,m/s^2}$$

From instant 1 to instant 2 $\quad a = 0\,m/s^2$

$$x_2 = x_1 + v_1 \Delta t + \cancel{\tfrac{1}{2} a (\Delta t)^2}^{\,0}$$

$$= 0\,m + 20\,m/s \times 0.50\,s = 10\,m$$

From 2 to 3 $\quad v_3^2 = v_2^2 + 2a\Delta x$

$$(0\,m/s)^2 = (20\,m/s)^2 + 2(-10\,m/s^2)\,\Delta x$$

$$\Rightarrow -400\,m^2/s^2 = -20\,m/s^2\,\Delta x$$

$$\Rightarrow \Delta x = 20\,m \Rightarrow x_3 - x_2 = 20\,m \Rightarrow x_3 - 10\,m = 20\,m$$

$$\Rightarrow x_3 = 30\,m$$

Space is $35\,m - 30\,m = \boxed{5.0\,m}$

Ch2 ~~Prob~~45 b

4^{ed} Prob 49b

b) Using previous set up:

		$a = -10\,m/s^2$	
time	$t_1 = 0s$	$t_2 = 0.50s$	$t_3 = ?$
	$x_1 = 0m$	$x_2 = ??$	$x_3 = 35m$
	$v_1 = ??$	$v_2 = v_1$	$v_3 = 0m/s$
		no acceleration	

(2) → (3) Then $v_3^2 = v_2^2 + 2a(x_3 - x_2)$

$$(0m/s)^2 = v_2^2 + 2(-10m/s^2)(35m - x_2)$$

$$\Rightarrow \quad v_2^2 = 20m/s^2(35m - x_2)$$

(1) → (2) Separately $x_2 = x_1 + v_1\Delta t + \frac{1}{2}\cancel{a(\Delta t)^2}$

$$x_2 = v_1\, 0.5s$$

Now $v_1 = v_2 \Rightarrow$ $v_1^2 = 20m/s^2(35m - v_1\, 0.5s)$

$$\Rightarrow \quad v_1^2 + 10v_1 - 700 = 0$$

$$v_1 = \frac{-10 \pm \sqrt{10^2 - 4(-700)}}{2}$$

$$= \frac{-10 \pm \sqrt{2900}}{2} = \frac{-10 \pm 54}{2}$$

Right moving $\Rightarrow v_1 > 0$ $\quad v_1 = 22m/s$

Knight Ch 2

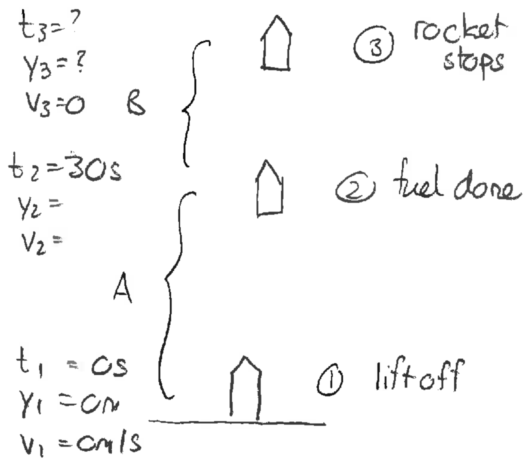
4ed Prob 55 ~~Prob 49~~

1) There are two stages

Ⓐ: $a = 30 m/s^2$

Ⓑ: $a = -g = -9.8 m/s^2$

Label variables as illustrated and adopt kinematic formulas for these. We ultimately need y_3. To do this we first find the remaining data at ②: Use stage A



stage A

$$v_2 = v_1 + a\,\Delta t$$

$$= v_1 + a(30s - 0s) = a\,30s$$

Here $a = 30 m/s^2$

$$\Rightarrow \quad v_2 = 30 m/s^2 \times 30s = 900 m/s$$

Also $y_2 = y_1 + v_1 \Delta t + \frac{1}{2} a \Delta t^2 = 0m + 0m/s\,\Delta t + \frac{1}{2}\, 30m/s^2 (t_2 - t_1)^2$

$$\Rightarrow y_2 = 15 m/s^2 (30s)^2 = 13500 m$$

additional data

$v_2 = 900 m/s$

$y_2 = 13500 m$

stage B

Now consider stage B: Here $\Delta t = t_3 - t_2 = t_3 - 30s$

$$y_3 = y_2 + v_2 \Delta t + \frac{1}{2} a \Delta t^2$$

requires Δt. To get this use $v_3 = v_2 + a\Delta t$

$$0 m/s = 900 m/s + (-9.8 m/s^2)\,\Delta t$$

$$\Rightarrow \Delta t = -\frac{900 m/s}{-9.8 m/s^2} = 92 s$$

So $y_3 = 13500m + 900 m/s (92s) + \frac{1}{2}(-9.8 m/s^2)(92s)^2$

$= 54800\,m$

4^{ed} Prob55

Knight Ch2
~~Prob 49~~

$t_i = 0\,s$
$v_i = 0\,m/s$
$y_i = 54800\,m$

$a = -9.8\,m/s^2$

$t_f = ?$
$y_f = 0\,m$
$v_f = ??$

b) $\boxed{\text{time to rise} = 92\,s + 30\,s = 122\,s}$

Need time to fall $\Delta t = t_f - t_i)$

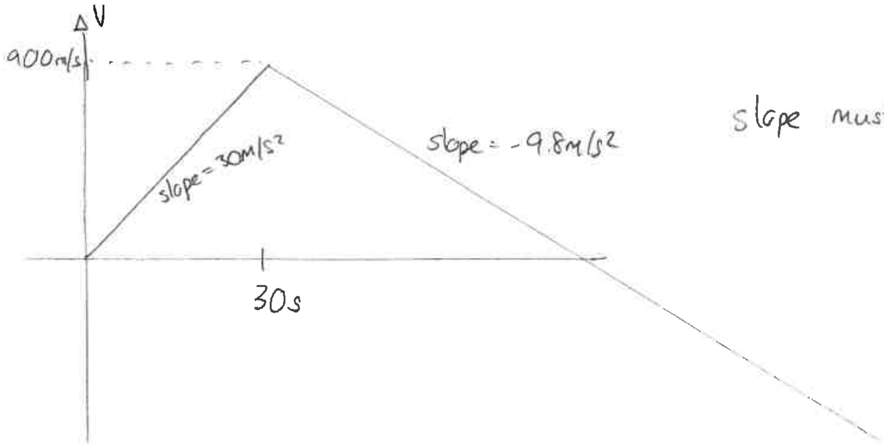
$$\cancel{y_f} = y_i + \cancel{v_i}\Delta t + \tfrac{1}{2}a(\Delta t)^2$$

$$\Rightarrow \quad 0 = 54800\,m + \tfrac{1}{2}(-9.8\,m/s^2)(\Delta t)^2$$

$$\Rightarrow \quad \Delta t = \sqrt{\frac{2 \times 54800\,m}{9.8\,m/s^2}} = 106\,s \quad \Leftarrow \boxed{\text{time to fall} = 106\,s}$$

So time for entire flight $= 106\,s + 122\,s = 228\,s$

c)

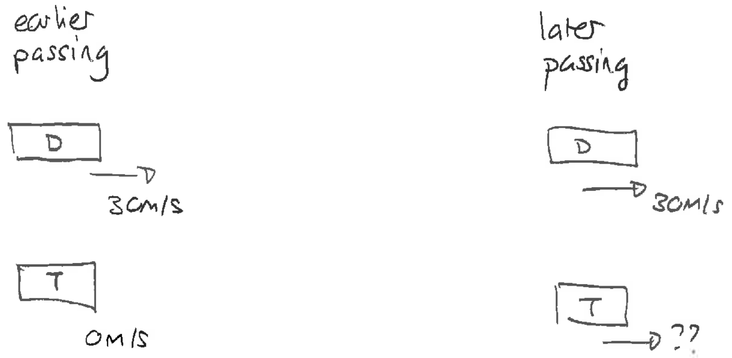


slope must be a

Knight Ch2

4ed Prob 68

a)



For David

$t_0 = 0s$ $\quad$ $t_1 = ?$

$x_{0D} = 0m$ $\quad$ $x_{1D} = ?$

$v_{0D} = 30m/s$ $\quad$ $v_{1D} = 30m/s$

$a_D = 0m/s^2$

$$x_{1D} = \overset{0}{\cancel{x_{0D}}} + v_{0D}\Delta t + \tfrac{1}{2}\overset{0}{\cancel{a_D}}(\Delta t)^2$$

$$x_{1D} = 0m + 30m/s\,\Delta t + 0m$$

$$x_{1D} = 30m/s\,\Delta t$$

Tina

$t_0 = 0s$ $\quad$ $t_1 =$

$x_{0T} = 0m$ $\quad$ $x_{1T} = ?$

$v_{0T} = 0m/s$ $\quad$ $v_{1T} = ??$

$a_T = 2m/s^2$

$$x_{1T} = \overset{0}{\cancel{x_{0T}}} + \overset{0}{\cancel{v_{0T}}}\Delta t + \tfrac{1}{2}a_T(\Delta t)^2$$

$$x_{1T} = \tfrac{1}{2}\,2.0m/s^2\,(\Delta t)^2$$

$$x_{1T} = 1.0m/s^2\,(\Delta t)^2$$

They meet at the same location $\Rightarrow$ $x_{1T} = x_{1D}$ and Δt is same. So

$$\overbrace{30m/s\,\Delta t}^{x_{1D}} = \overbrace{1.0m/s^2\,(\Delta t)^2}^{x_{1T}}$$

$$\Rightarrow \frac{30m/s}{1\,m/s^2} = \Delta t \Rightarrow \boxed{\Delta t = 30s}$$

Then $x_{1D} = 30m/s\,\Delta t \Rightarrow \boxed{x_{1D} = 900m}$

b) $v_1 = v_0 + a\,(\Delta t)^2$

b) $V_{1T} = V_{0T} + a_T(\Delta t)$

$V_{1T} = 0m/s^2 + 2.0m/s^2 \times 30s \Rightarrow$ $\boxed{V_{1T} = 60m/s}$